3-D ANALYSIS OF BUILDING FRAME USING STAAD-PRO

A Thesis submitted in partial fulfillment of the requirements for the degree of

Bachelor of Technology in "Civil Engineering"

By

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ODISHA, INDIA-769008

CERTIFICATE

This is to certify that the thesis entitled "**3-D Analysis of Building Frame Using STAAD-PRO** ", submitted by **Ashis Debashis Behera (108CE021)** in partial fulfillment of the requirements for the award of **Bachelor of Technology** in **Civil Engineering** during session 2011-2012 at National Institute of Technology, Rourkela. A bonafide record of research work carried out by them under my supervision and guidance.

The candidates have fulfilled all the prescribed requirements.

The Thesis which is based on candidates' own work, have not submitted elsewhere for a degree/diploma.

In my opinion, the thesis is of standard required for the award of a bachelor of technology degree in CIVIL Engineering.

Place: Rourkela

Dept. of Civil Engineering
National institute of Technology

Prof. K.C.Biswal
Associate Professor

ACKNOWLEDGEMENTS

On the submission of my thesis entitled "**3-D Analysis Of Building Frame Using STAAD-PRO**", I would like to extend my gratitude & my sincere thanks to my supervisor **Prof. K.C. Biswal**, Associate Professor, Department of Civil Engineering for his constant motivation and support during the course of my work in the last one year. I truly appreciate and value his esteemed guidance and encouragement from the beginning to the end of this thesis. His knowledge and guidance at the time of crisis would be remembered lifelong.

I am very thankful to **Prof. Ramakar Jha for** his valuable suggestions and comments during this project period.

I am very thankful to my teachers for providing solid background for my studies and research thereafter. They have great sources of inspiration to us and I thank them from the bottom of my hearts.

At last but not least, I would like to thank the staff of Civil engineering department for constant support and providing place to work during project period. I would also like to extend my gratitude to my friends who are with us during thick and thin and Mr. Sukumar Behera for his help during my project.

ASHIS DEBASHIS BEHERA

B.Tech (Civil Engineering)

ABSTRACT

In these modern days the Buildings are made to fulfill our basic aspects and better Serviceability. It is not an issue to construct a Building any how its, important to construct an efficient building which will serve for many years without showing any failure. The Project titled “3-D ANALYSIS OF BUILDING FRAME USING STAAD-PRO”, aims in finding Better technique for creating Geometry, Defining the cross sections for column and beam etc, Creating specification and supports (to define a support weather it is fixed or pinned),then the Loads are defined. After that the model is analyzed by ‘run analysis’. Then reviewing (whether beam column passed in loads or failed) results. Then the design is performed.

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Chapter-1: INTRODUCTION

GENRAL INTRODUCTION

In 21st century due to huge population the no of areas in units are decreasing day by day. Few years back the populations were not so vast so they used to stay in Horizontal system(due to large area available per person).But now a day's people preferring Vertical System(high rise building due to shortage of area).In high rise buildings we should concern about all the forces that act on a building ,its own weight as well as the soil bearing capacity .For external forces that act on the building the beam, column and reinforcement should be good enough to counteract these forces successfully. And the soil should be good enough to pass the load successfully to the foundation. For loose soil we preferred deep foundation (pile).If we will do so much calculation for a high rise building manually then it will take more time as well as human errors can be occurred. So the use of STAAD-PRO will make it easy. STAAD-PRO can solve typical problem like Static analysis, Seismic analysis and Natural frequency. These type of problem can be solved by STAAD-PRO along with IS-CODE. Moreover STAAD-PRO has a greater advantage than the manual technique as it gives more accurate and precise result than the manual technique.

STAAD-PRO was born giant. It is the most popular software used now a days.Basically it is performing design works. There are four steps using STAAD-PRO to reach the goal.

- Prepare the input file.
- Analyze the input file.
- Watch the results and verify them.
- Send the analysis result to steel design or concrete design engines for designing purpose.

1. Prepare the input file-

   - First of all we described the structure. In description part we include geometry, the materials, cross sections, the support conditions.

2. Analyze the input file-

   - We should sure that we are using STAAD-PRO syntax. Else it will error.
   - We should sure that all that we are inputting that will generate a stable structure .Else it will show error.
   - At last we should verify our output data to make sure that the input data was given correctly.

3. Watch the results and verify them.

   - Reading the result take place in POST PROCESSING Mode.
   - First we choose the output file that we want to analyze (like various loads or load combination) .Then it will show the results.

4. Send the analysis result to steel design or concrete design engines for designing purpose.

   - If someone wants to do design after analysis then he can ask STAAD-PRO to take the analysis results to be designed as design
   - The data like Fy main,Fc will assign to the view
   - Then adding design beam and design column.
   - Running the analysis it will show the full design structure.

Chapter-2: LITRATURE REVIEW

Viviane Warnotte summarized basic concepts on which the seismic pounding effect Occurs between adjacent buildings. He identified the conditions under which the seismic Pounding will occur between buildings and adequate information and, perhaps more Importantly, pounding situation analyzed. From his research it was found that an elastic model cannot predict correctly the behaviors of the structure due to seismic pounding. Therefore non-elastic analysis is to be done to predict the required seismic gap between buildings.

Shehata E. Abdel Raheem developed and implemented a tool for the inelastic analysis of seismic pounding effect between buildings. They carried out a parametric study on buildings pounding response as well as proper seismic hazard mitigation practice for adjacent buildings. Three categories of recorded earthquake excitation were used for input. He studied the effect of impact using linear and nonlinear contact force model for different separation distances and compared with nominal model without pounding consideration.

Robert Jankowski addressed the fundamental questions concerning the application of the nonlinear analysis and its feasibility and limitations in predicting Seismic pounding gap between buildings. In his analysis, elastoplastic multi-degree of freedom. Lumped mass models are used to simulate the structural behavior and non-linear viscoelastic impact elements are applied to model collisions. The results of the study Prove that pounding may have considerable influence on behavior of the structures.

Chapter-3: FORMULATION OF PROBLEM

3.1 TYPES OF LOAD USED

DEAD LOAD (DL):-DEAD LOAD is defined as the the load on a structure due to its own weight (self-weight). It also added other loads if some permanent structure is added to that structure.

LIVE LOAD (LL):-LIVE LOAD Or IMPOSED LOAD is defined as the load on the structure due to moving weight. The LIVE LOAD varies according to the type of building. For example generally for a Residential Building the LIVE LOAD is taken as 2kn/m^2.

WIND LOAD (WL):-WIND LOAD is defined as the load on a structure due to wind intensities. Generally wind intensities vary from time to time. So it is suggested to take maximum probable wind intensities calculation for a structure for which damage can be avoided.

SEISMIC LOAD (SL):-SEISMIC LOAD can be calculated taking the view of acceleration response of the ground to the super structure. According to the severity of earthquake intensity they are divided into 4 zones.

1. Zone I and II are combined as zone II.
2. Zone III.
3. Zone IV.
4. Zone V.

3.2 CALCULATION OF LOADS

1. DEAD LOAD CALCULATION:

MAIN WALL LOAD (From above plinth area to below the Roof) should be the cross sectional area of the wall multiplied by unit weight of the brick. (unit weight of brick is taken as 19.2 kn/m^3).

According to the IS-CODE PLINTH LOAD should be half of the MAIN WALL LOAD.Internl PLINTH LOAD should be half of the PLINTH LOAD.

PARAPATE LOAD should be the cross sectional is multiplied by unit weight.

SLAB LOAD should be combination of slab load plus floor finishes. SLAB LOAD can be calculated as the thickness of slab multiplied by unit weight of concrete (according to IS-CODE unit weight of concrete is taken as 25 kn/m^3).and FLOOR FINISHES taken as .5-.6 $kn/m^{2.}$

2. LIVE LOAD CALCULATION:

LIVE LOAD is applied all over the super structure except the plinth .Generally LIVE LOAD varies according to the types of building. For Residential building LIVE LOAD is taken as ----$2kn/m^2$ on each floor and $-1.5kn/m^2$ on roof.Negetive sign indicates its acting on downward direction.

3. WIND LOAD CALCULATION:

According to IS CODE (875 PART 3), $Vz = Vb \times K1 \times K2 \times K3$

Where Vz=design wind speed at a height z meter in m/s.

Vb=basic design wind speed at 10m height. For example Vb is 50 m/s for cities like Cuttack and Bhubaneswar and 39 m/s for Rourkela.K1, K2, K3 can be calculated from the IS-CODE(875 part3).

Pz=Design wind pressure at a height z meter.

$Pz=0.6\ Vz^2$

- SEISMIC LOAD CALCULATION:

  According to the IS-CODE 1893(part 1) the horizontal Seismic coefficient Ah for a structure can be formulated by the following expression

  $Ah=ZISa/2RG$

  WHERE

  Z=Zone factor depending upon the zone the structure belongs to.

  For Zone II (z=0.1)

  For Zone III (Z=0.16)

  For Zone IV (Z=0.24)

  For Zone V (Z=.36)

  I=Importance factor.

  For important building like hospital it is taken as 1.5 and other for other building it is taken as 1.

  R=Response reduction factor.

  Sa/g=Average Response Acceleration coefficient.

  However it should be notice that the ratio of I and R should not be greater than 1.

3.3. LOAD COMBINTION

- For seismic load analysis of a building the code refers following load combination.
  - 1.5(DL + IL)
  - 1.2(DL + IL ± EL)
  - 1.5(DL ± EL)
  - 0.9 DL ± 1.5 EL

2. For wind load analysis of a building the code refers following load combination.

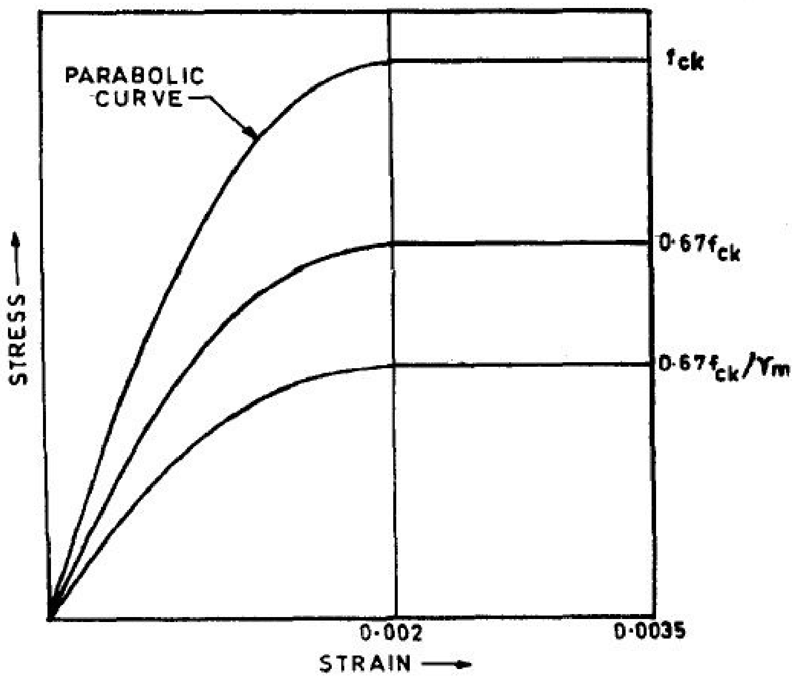
- DL +LL
- DL+WL
- DL+0.8LL+0.8WL

Both WL and EL are applied in X and Z direction. These loads are also applied further in negative X and Z direction.

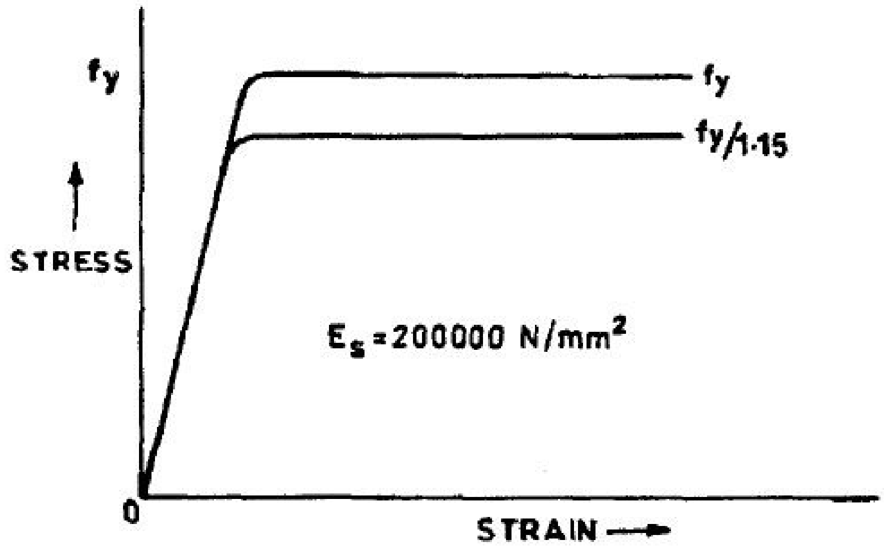
So for Seismic analysis there are 18 load combinations and for Wind load analysis there are 11 load combinations.

REINFORCED CONCRETE CEMENT:

Generally concretes are strong in compression and very negligible respond (almost zero) to the tension. So reinforced (steel bars) are provided to resist the tension and to counteract the moment which can't resist by the concrete. The partial safety factor for concrete generally taken as 1.5 due to non-uniform compaction and inadequate curing and partial safety factor for steel is taken as 1.15.The compressive strength of concrete is always taken as because it is always lesser than the cube strength. So for the design work the maximum strength of the concrete is taken as - $0.67f_{ck}/1.5=.45f_{ck}$ and for steel is $f_y/1.15=.87\ f_y$



STRESS-STRAIN CURVE FOR CONCRETE



STEEL BAR WITH DEFINITE YIELD POINT

REPRESENTATIVE STRESS-STRAIN CURVES FOR REINFORCEMENT

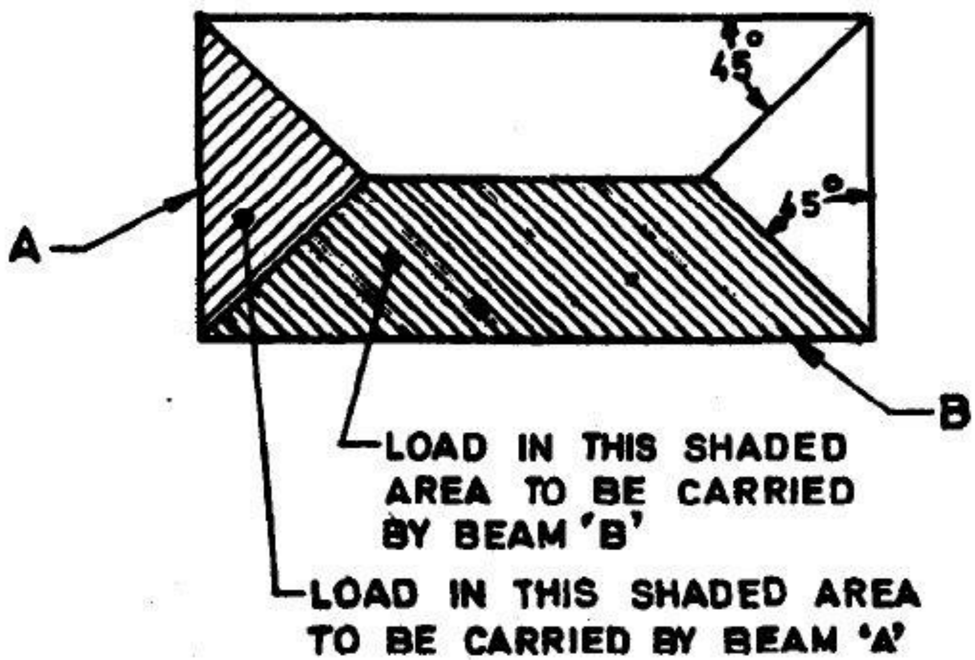
BEAM:-Effective depth of a beam is the distance between centroid of area the tension member to the maximum compression member. Generally the span length to effective depth ratio is taken as followings for different beams.

CANTILEVER-7

SIMPLY SUPPORTED-20

CONTINUOUS-26

The Reinforced should be given both transversally and longitudionally.Transverse reinforcement is provided to hold the longitudinal bar in its position. Maximum reinforcement for beam shouldn't be more than 6percent.



LOAD CARRIED BY SUPPORTING BEAMS

The minimum shear reinforcement for a beam should be .75d or 300mm which is lesser.

COLUMN:-The member who takes compressional load is known as column or struct.

Basically column can be define as Long or Short according to the L and D ratio.

If l_{ex} /B or l_{ey}/D more than or equal to 12 then that is called long column else short column.

Where

l_{ex} is the effective length in X-axis.

l_{ey} is the effective length in Y-axis.

B is the breadth of member.

D is the effective depth of member.

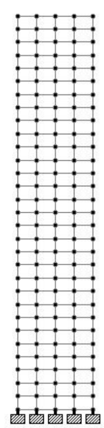
Generally code permits reinforcement up to 6% in column But in site maximum 2.5% reinforcement are taken. Generally in middle portion of the column more sizes are taken because it took more load than others.

Chapter-4: COMPARISION OF TWO 30-STOREY BUILDING

COMPARISION OF TWO 30-STOREY BUILDING

After the basic work is done. Then it was made with two different load combination.1st 30-storey building was made with the combination of seismic load, live load and dead load. And 2nd 30-storey building was made with the combination of wind load, live load and dead load .The Beam and column size of both buildings are same. Internal column size are (0.8m×0.8m).External column size was taken as (.75m×.75m).The beam size was taken as (.45m×.3m).More internal size was taken because it always taken more load than the external. If greater size will not provide then it will fail in compression.

FOLLOWINGS ARE THE INPUT DATA , CONCRETE DESIGN,DEFLECTION AND SHEAR BENDING OF A 30 STOREY BUILDIG USING DEAD LOAD,SEISMIC LOAD AND WIND LOAD COMBINATION…

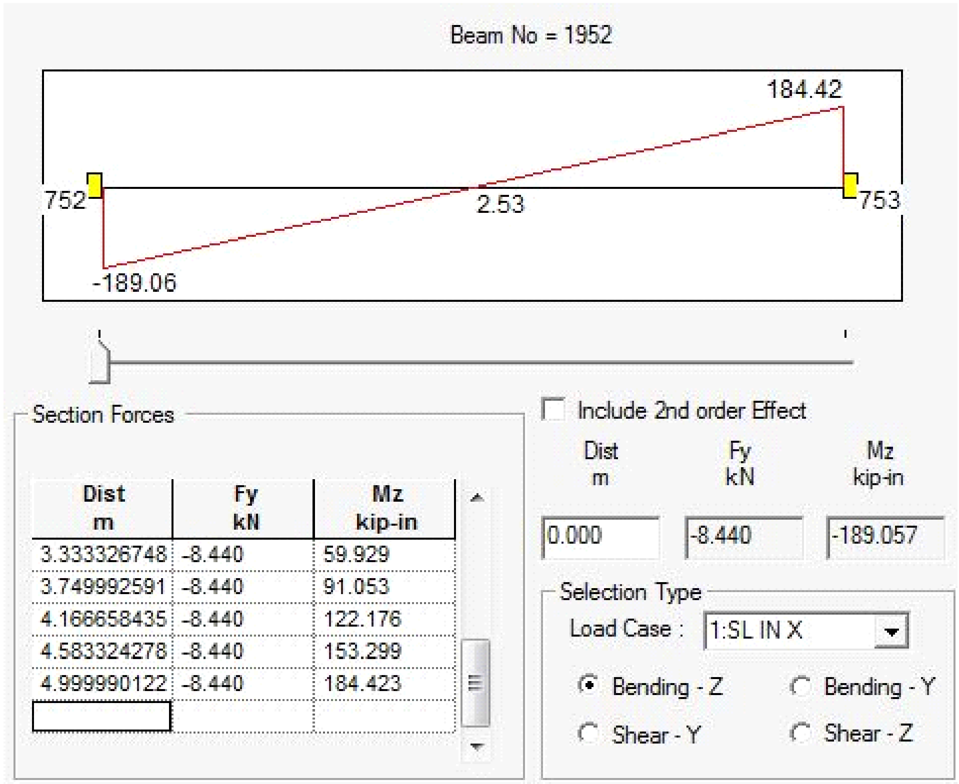


(A 30 storey building under seismic, live and dead load combination)

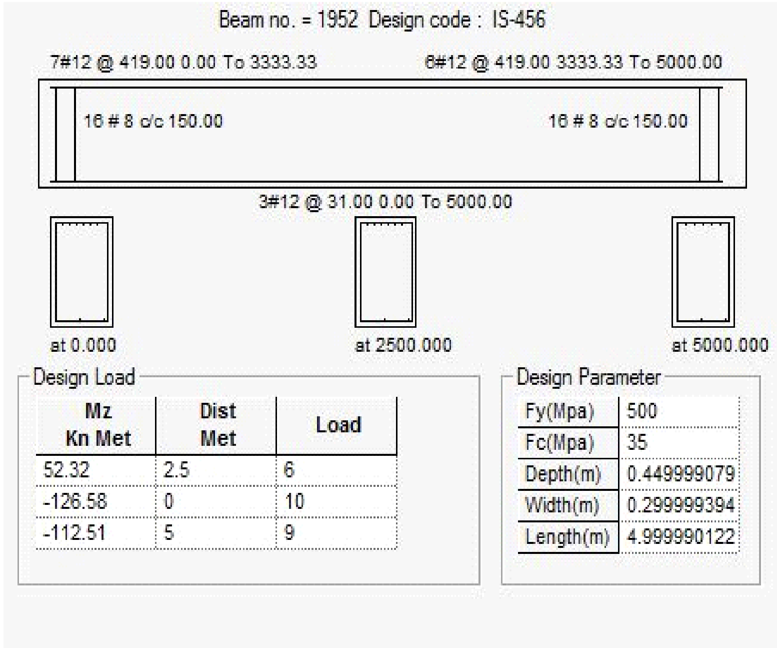
DATA REQUIRED FOR THE ANALYSIS OF THEFRAME..

- Type of structure --> multi-storey fixed jointed plane frame.
- Seismic zone II (IS 1893 (part 1):2002)

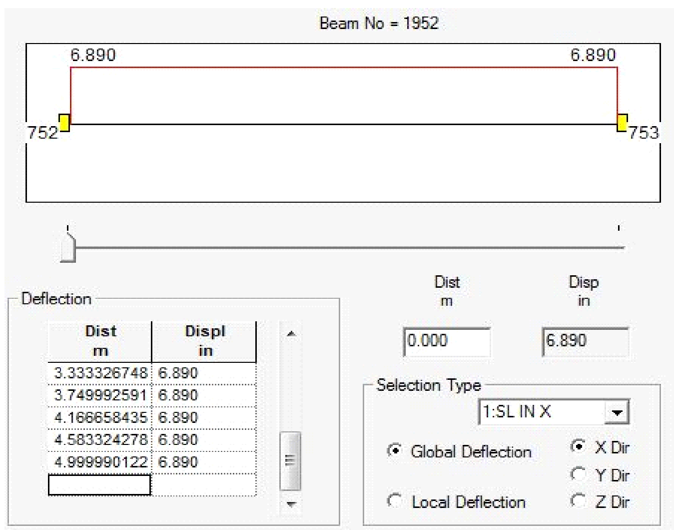
- Number of stories 30, (G+29)
- Floor height 3.5 m
- No of bays and bay length 4nos,5 m each.
- Imposed load 2 kn/m^2 on each floor and 1.5 kn/m^2 on roof.
- Materials Concrete (M 35) and Reinforcement (Fe500).
- Size of column .8m×.8m internal column size,.75m×.75m external column size.
- Size of beam .45m×.45m
- Depth of slab 125 mm thick
- Specific weight of RCC 25kn/m^3.
- Specific weight of infill 19.2 kn/m^3
- Type of soil Medium soil.
- Response spectra As per IS 1893.



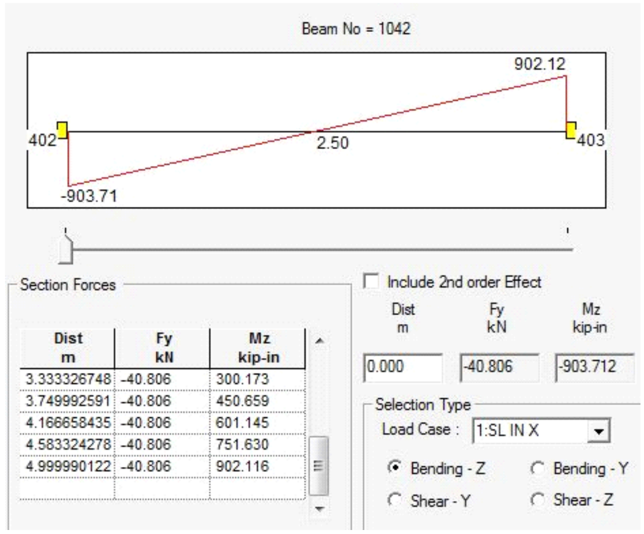
(Shear bending of beam no. 1952)



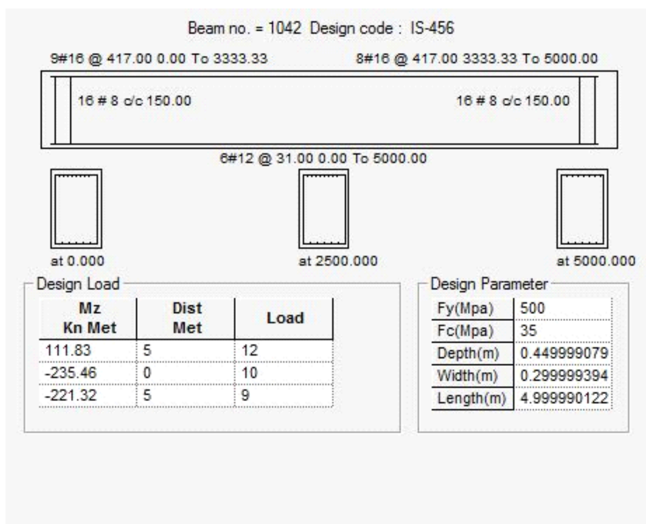
(Concrete design of the beam 1952)



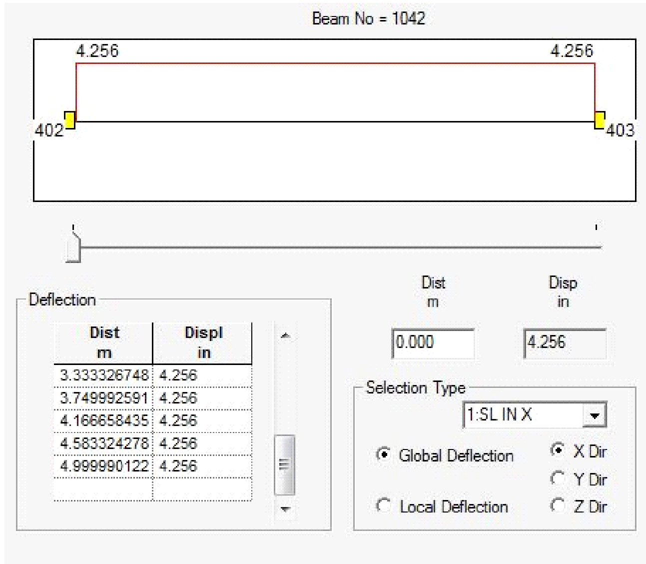
(Deflection of the beam 1952)



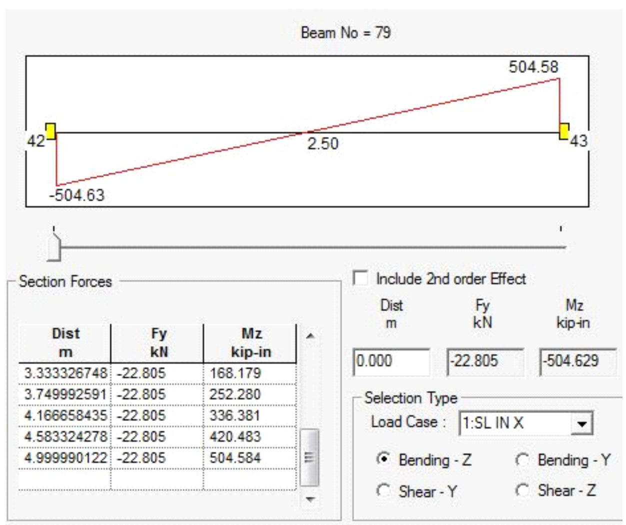
(SHEAR BENDING OF BEAM NO. 1042)



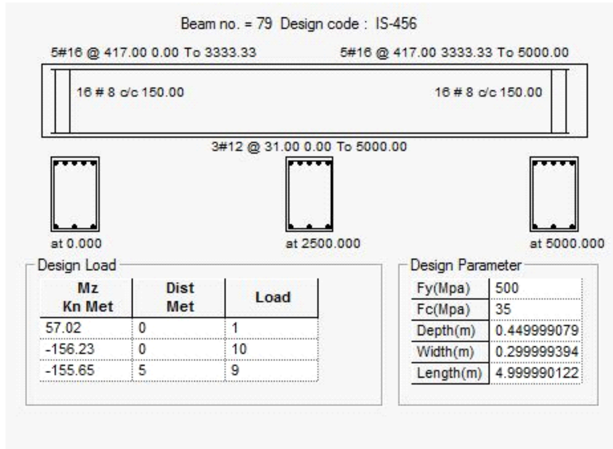
(CONCRETE DESIGN OF BEAM NO. 1042)



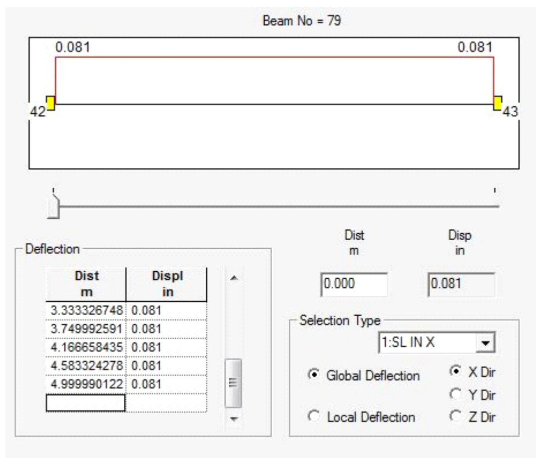
(DEFLECTION OF THE BEAM 1042)



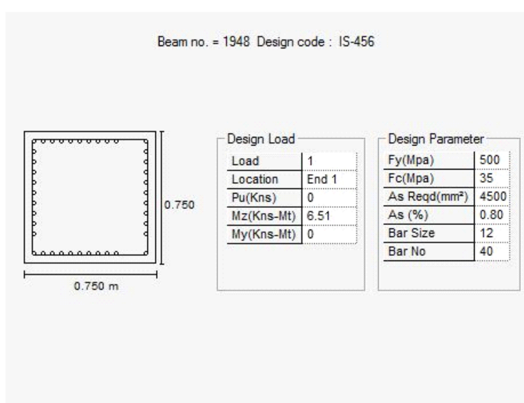
(SHEAR BENDING OF BEAM NO 79)



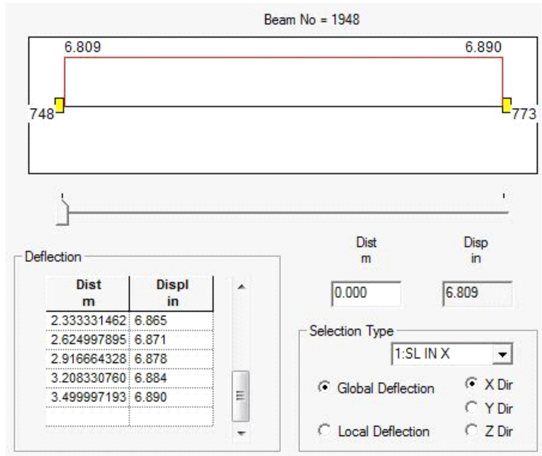
(CONCRETE DESIGN OF BEAM 79)



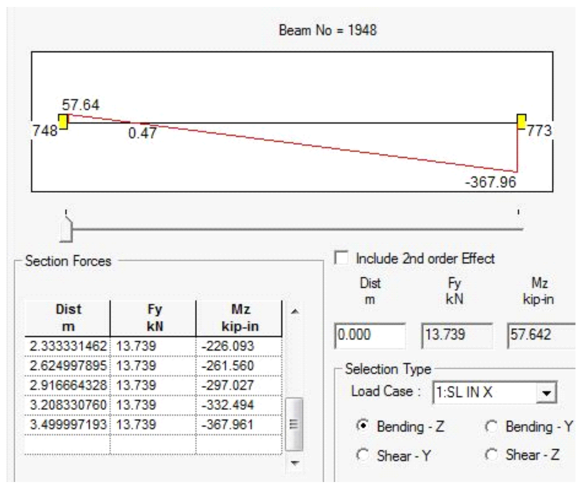
(DEFLECTION OF BEAM 79)



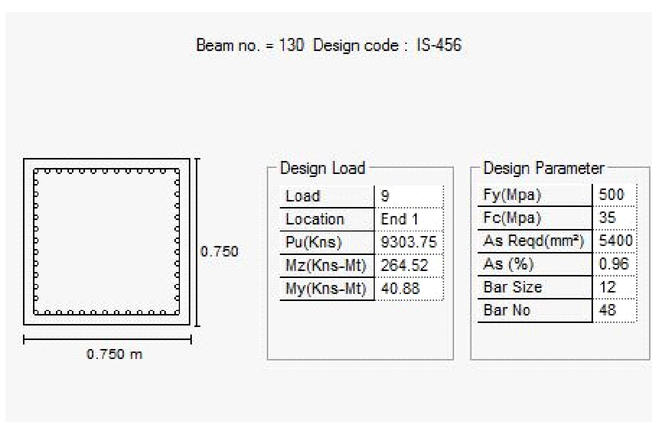
(CONCRETE DESIGN OF COLUMN NO.1948)



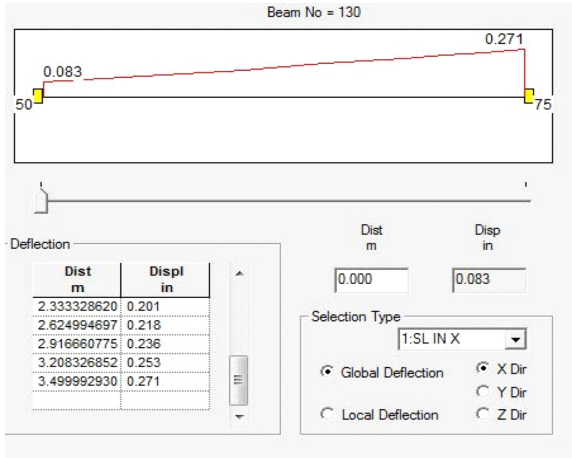
(DEFLECTION OF COLUMN NO.1948)



(SHEAR BENDING OF COLUMN NO.1948)



(CONCRETE DESIGN OF COLUMN NO.130)



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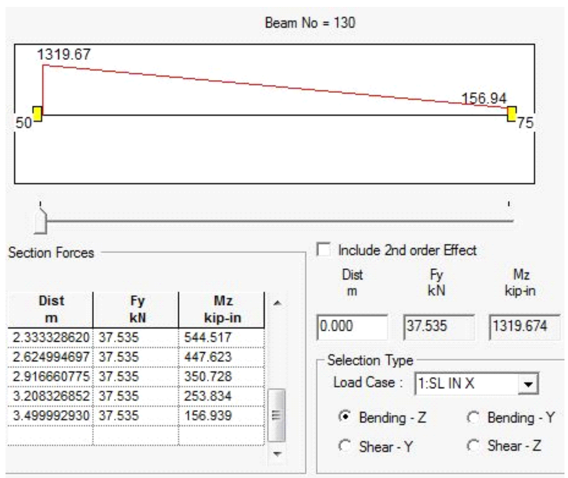

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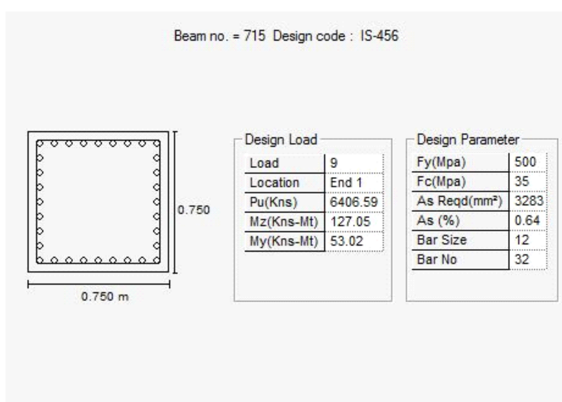
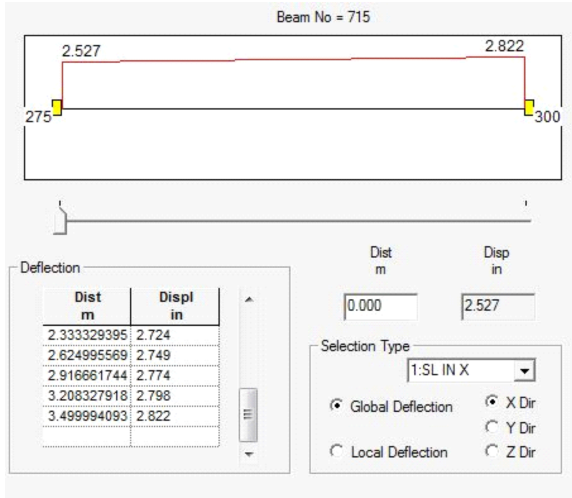


(CONCRETE DESIGN OF COLUMN NO.715)



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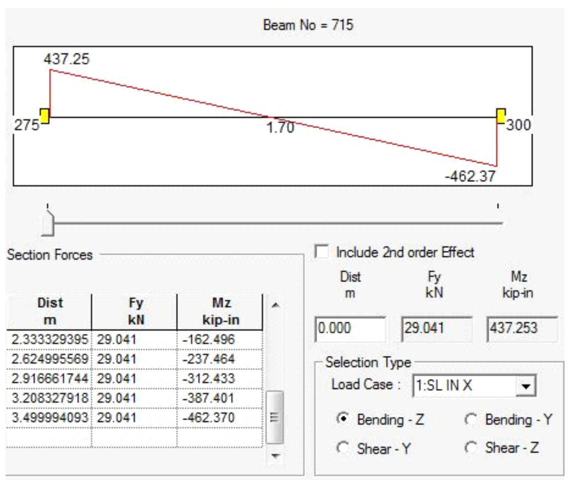


(SHEAR BENDING OF COLUMN NO.715)

B E A M N O. 79 D E S I G N R E S U L T S

M35   Fe500 (Main)   Fe500 (Sec.)

LENGTH: 5000.0 mm   SIZE: 300.0 mm X 450.0 mm   COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	1250.0 mm	2500.0 mm	3750.0 mm	5000.0 mm
TOP REINF.	983.35 (Sq. mm)	218.28 (Sq. mm)	213.69 (Sq. mm)	217.22 (Sq. mm)	979.15 (Sq. mm)
BOTTOM REINF.	325.04 (Sq. mm)	286.26 (Sq. mm)	286.28 (Sq. mm)	287.91 (Sq. mm)	245.30 (Sq. mm)

SUMMARY OF PROVIDED REINF. AREA

SECTION	0.0 mm	1250.0 mm	2500.0 mm	3750.0 mm	5000.0 mm
TOP REINF.	5-16í 1 layer(s)	3-16í 1 layer(s)	3-16í 1 layer(s)	3-16í 1 layer(s)	5-16í 1 layer(s)
BOTTOM REINF.	3-12í 1 layer(s)	3-12í 1 layer(s)	3-12í 1 layer(s)	3-12í 1 layer(s)	3-12í 1 layer(s)
SHEAR REINF.	2 legged 8í @ 150 mm c/c	2 legged 8í @ 150 mm c/c	2 legged 8í @ 150 mm c/c	2 legged 8í @ 150 mm c/c	2 legged 8í @ 150 mm c/c

(DETAILED OF TOP, BOTTOM REINFORCEMENT AND

PROVIDED REINFORCEMENT PROVIDED FORBEAM 79)

B E A M N O. 1106 D E S I G N R E S U L T S

M35   Fe500 (Main)   Fe500 (Sec.)

LENGTH: 5000.0 mm   SIZE: 300.0 mm X 450.0 mm   COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	1250.0 mm	2500.0 mm	3750.0 mm	5000.0 mm
TOP REINF.	1687.68 (Sq. mm)	435.80 (Sq. mm)	0.00 (Sq. mm)	244.98 (Sq. mm)	972.72 (Sq. mm)
BOTTOM REINF.	491.03 (Sq. mm)	322.70 (Sq. mm)	262.47 (Sq. mm)	544.66 (Sq. mm)	621.23 (Sq. mm)

SUMMARY OF PROVIDED REINF. AREA

SECTION	0.0 mm	1250.0 mm	2500.0 mm	3750.0 mm	5000.0 mm
TOP REINF.	9-16í 2 layer(s)	3-16í 1 layer(s)	2-16í 1 layer(s)	3-16í 1 layer(s)	5-16í 1 layer(s)
BOTTOM REINF.	3-20í 1 layer(s)	3-20í 1 layer(s)	3-20í 1 layer(s)	3-20í 1 layer(s)	3-20í 1 layer(s)
SHEAR REINF.	2 legged 8í @ 150 mm c/c	2 legged 8í @ 150 mm c/c	2 legged 8í @ 150 mm c/c	2 legged 8í @ 150 mm c/c	2 legged 8í @ 150 mm c/c

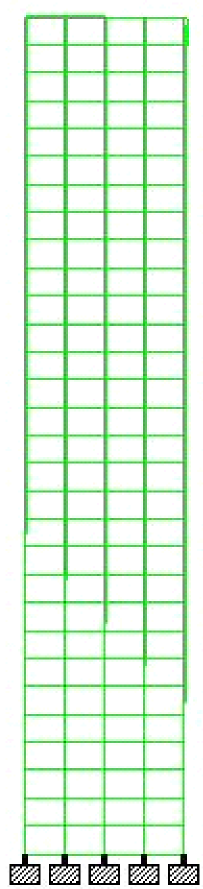
(DETAILED OF TOP, BOTTOM REINFORCEMENT AND PROVIDED

REINFORCEMENT PROVIDED FOR BEAM 1106)

```
        C O L U M N   N O.  1817  D E S I G N   R E S U L T S

      M35                  Fe500 (Main)              Fe500 (Sec.)

LENGTH:  3500.0 mm   CROSS SECTION:  750.0 mm X  750.0 mm  COVER: 40.0 mm

** GUIDING LOAD CASE:    1 END JOINT:   697  SHORT COLUMN


REQD. STEEL AREA   :     4500.00 Sq.mm.
REQD. CONCRETE AREA:   558000.00 Sq.mm.
MAIN REINFORCEMENT : Provide  40 - 12 dia. (0.80%,   4523.89 Sq.mm.)
                     (Equally distributed)
TIE REINFORCEMENT  : Provide  8 mm dia. rectangular ties @ 190 mm c/c

SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)
----------------------------------------------------------
Puz :  10476.00   Muz1 :    638.04   Muy1 :    638.04

INTERACTION RATIO: 0.01 (as per Cl. 39.6, IS456:2000)

SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)
----------------------------------------------------------
WORST LOAD CASE:    10
END JOINT:   722 Puz :  10484.58   Muz :    888.30   Muy :    888.30   IR: 0.17
============================================================================


          C O L U M N   N O.  1934  D E S I G N   R E S U L T S

        M35                  Fe500 (Main)              Fe500 (Sec.)

    LENGTH:  3500.0 mm   CROSS SECTION:  800.0 mm X  800.0 mm  COVER: 40.0 mm

    ** GUIDING LOAD CASE:    2 END JOINT:   734  SHORT COLUMN

  --------------------------------< PAGE 2708 Ends Here >---------------------------
     STAAD SPACE                                             -- PAGE NO. 2709


    REQD. STEEL AREA   :     5120.00 Sq.mm.
    REQD. CONCRETE AREA:   634880.00 Sq.mm.
    MAIN REINFORCEMENT : Provide  48 - 12 dia. (0.85%,   5428.67 Sq.mm.)
                         (Equally distributed)
    TIE REINFORCEMENT  : Provide  8 mm dia. rectangular ties @ 190 mm c/c

    SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)
    ----------------------------------------------------------
    Puz :  11919.36   Muz1 :    782.95   Muy1 :    782.95

    INTERACTION RATIO: 0.01 (as per Cl. 39.6, IS456:2000)

    SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)
    ----------------------------------------------------------
    WORST LOAD CASE:     7
    END JOINT:   759 Puz :  12030.25   Muz :    925.45   Muy :    925.45   IR: 0.11
```

(REQUIRED STEEL AND CONCRETE AREA, MAIN AND TIE RENFORCEMENT, SECTION CAPACITY FOR COLUMN NO. 1817 AND 1934)

Followings are the Input Data concrete design, deflection and shear bonding for different beam in WIND load, Dead load and Live LOAD Combination…



(A 30 storey building under wind, live and dead load combination)

DATA REQUIRED FOR THE ANALYSIS OF THE FRAME..

1. Type of structure --> multi-storey fixed jointed plane frame.

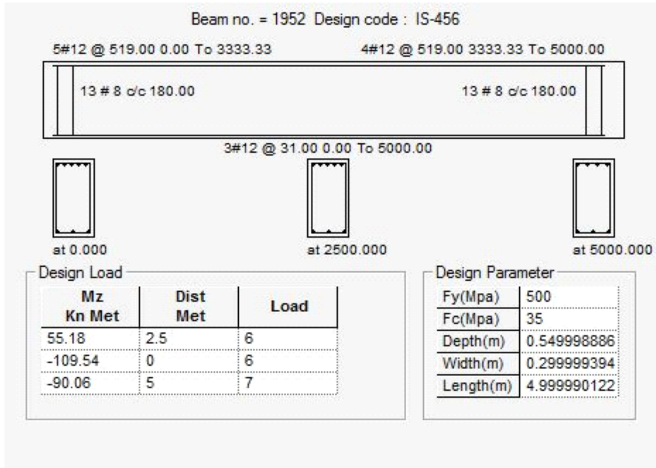
2. Number of storeys 30, (G+29) No of bays and bay length 4nos, 5 m each.

3. Floor height 3.5 m

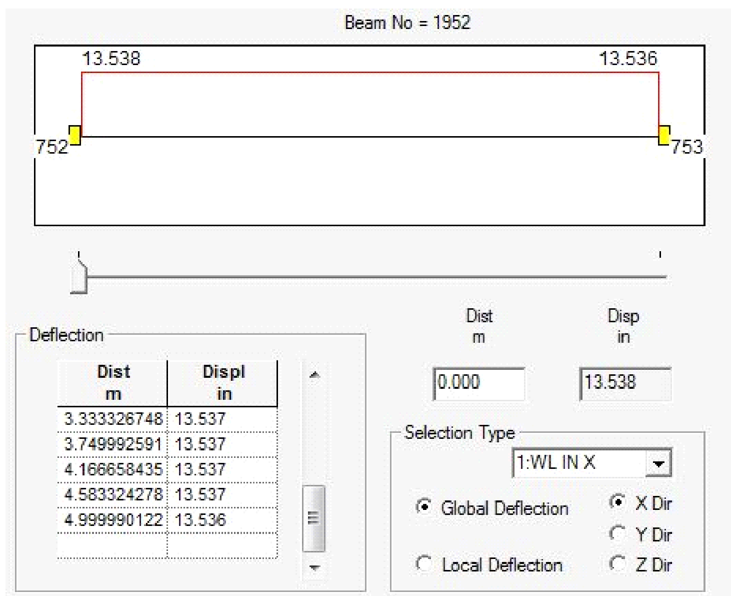
4. No of bays and bay length 4nos, 5 m each.

5. Basic wind speed As per IS 875 (PART 3), 50 m/s for CTC.

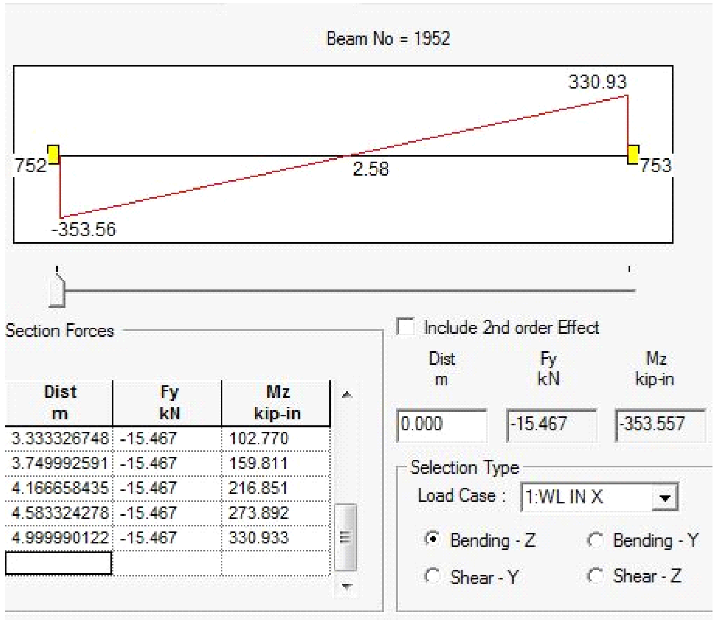
- Imposed load 2 kn/m^2 on each floor and 1.5 kn/m^2 on roof.
- Materials Concrete (M 35) and Reinforcement (Fe500).
- Size of column .8m×.8m internal column size 75m×.75m external column size.
- Size of beam .45m×.45m
- Depth of slab 125 mm thick
- Specific weight of RCC 25kn/m^3.
- Specific weight of infill 19.2 kn/m^3
- Wind intensity and height As per IS 875 (PART 3),1.5 kn/m^2 at a height 105 m in CTC.



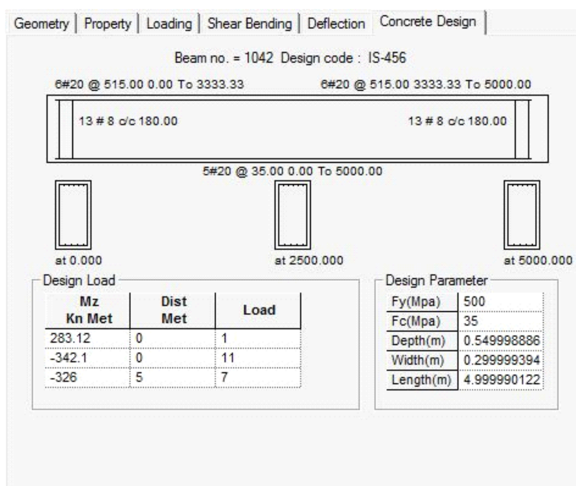
(CONCRETE DESIGN FOR BEAM NO.1952)



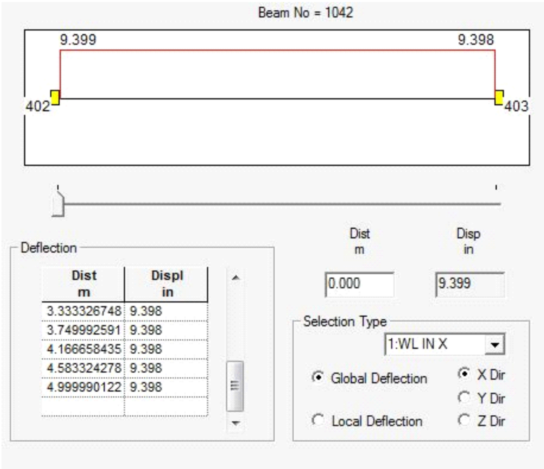
(DEFLECTION FOR BEAM NO.1952)



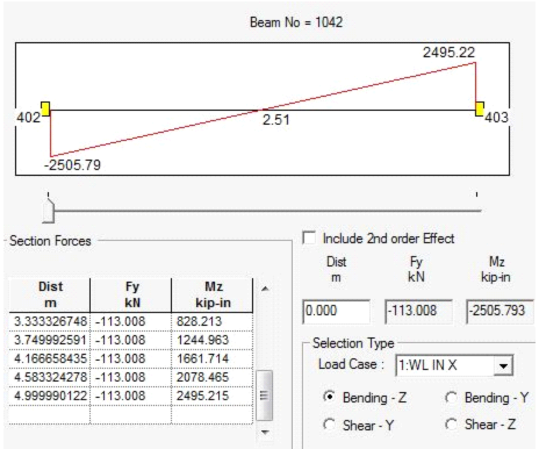
(SHEAR BENDING FOR BEAM NO. 1952)



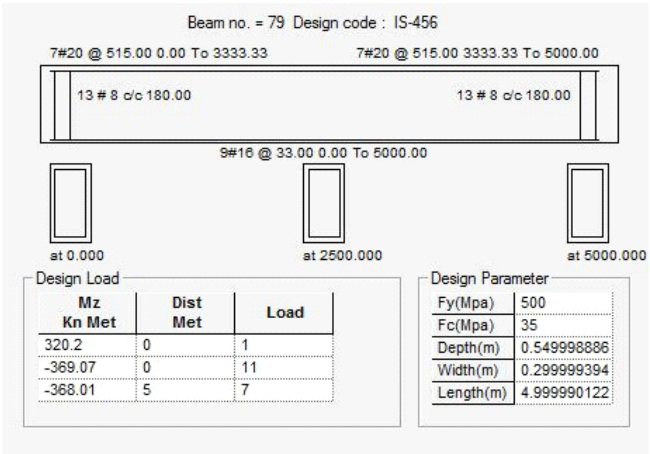
(CONCRETE DESIGN FOR BEAM NO.1042)



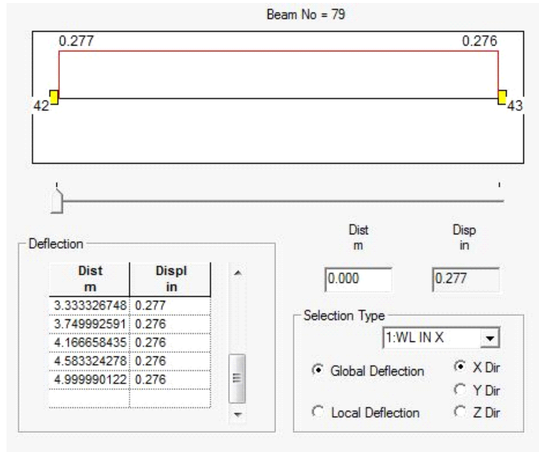
(DEFLECTION FOR BEAM NO.1042)



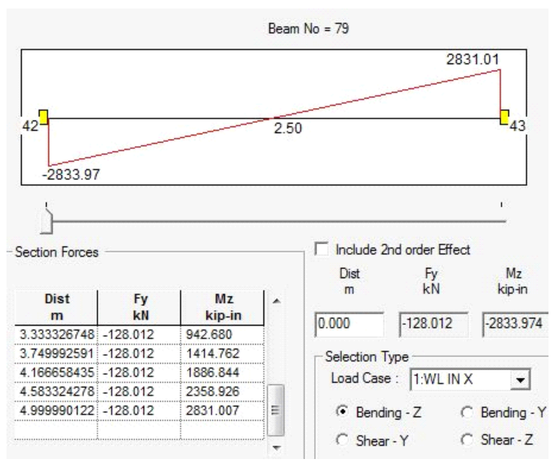
(SHEAR BENDING FOR BEAM NO. 1042)



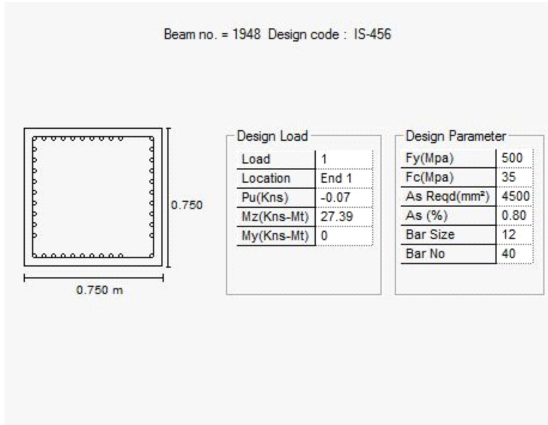
(CONCRETE DESIGN FOR BEAM NO.79)



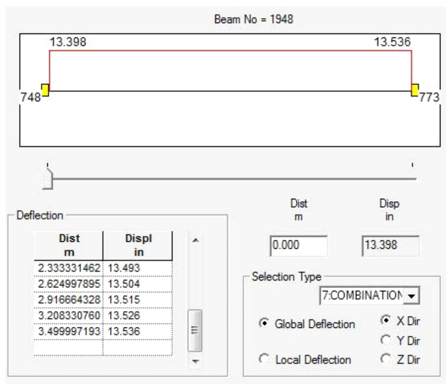
(DEFLECTION FOR BEAM NO.79)



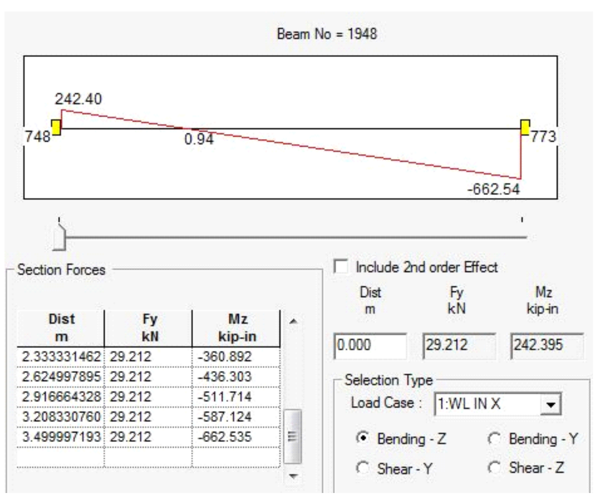
(SHEAR BENDING FOR BEAM NO. 79)



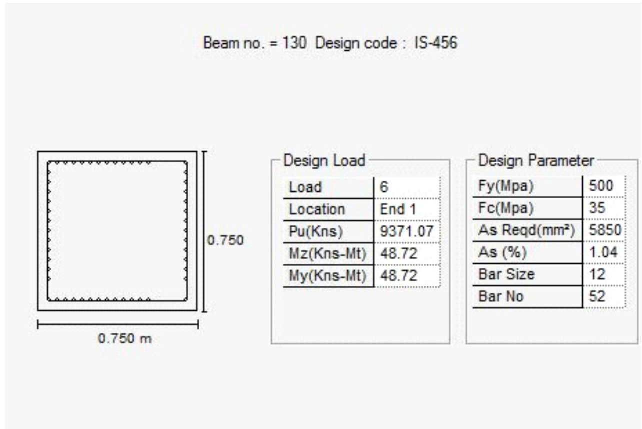
(CONCRETE DESIGN FOR COLUMN NO.1948)



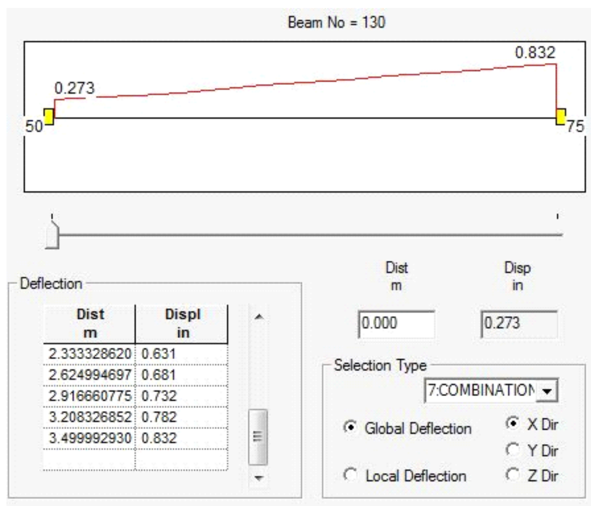
(DEFLECTION FOR COLUMN NO.1948)



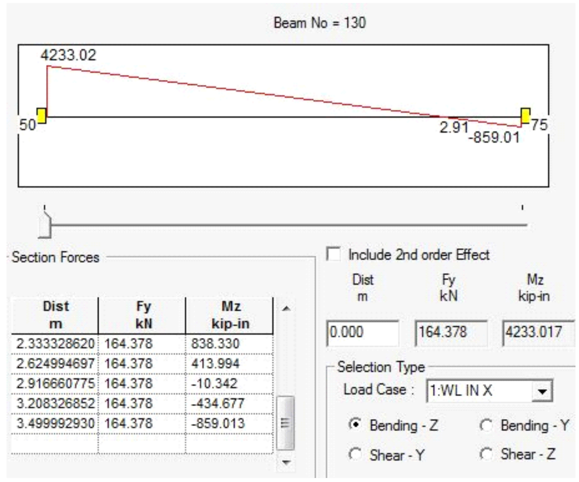
(SHEAR BENDING FOR COLUMN NO.1948)



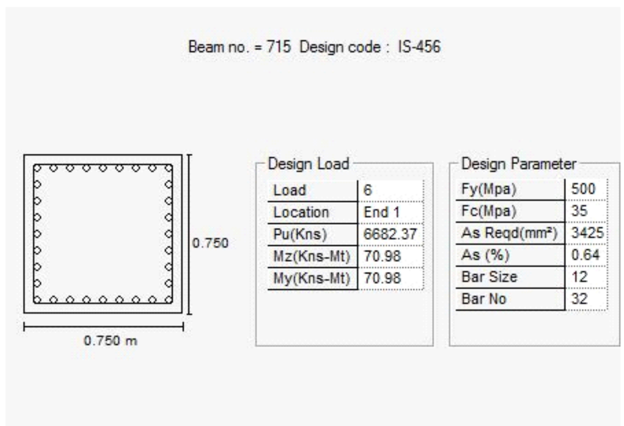
(CONCRETEDESIGN FOR COLUMN NO.130)



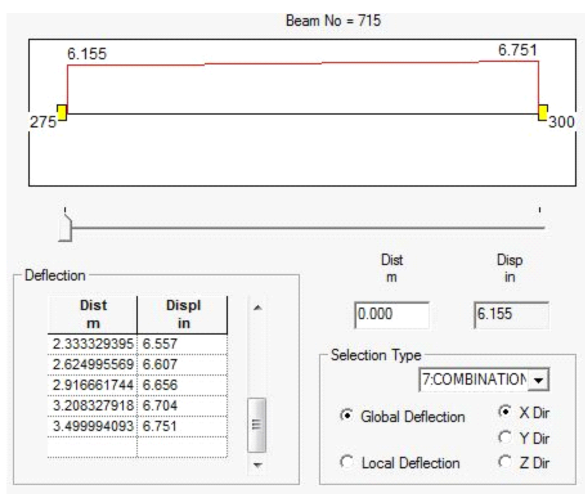
(DEFLECTION FOR COLUMN NO.130)



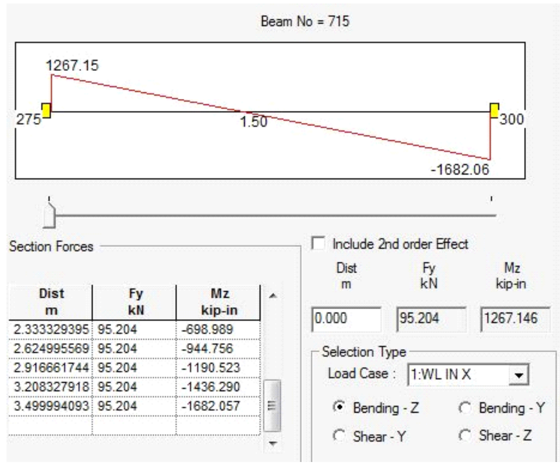
(SHEAR BENDING FOR COLUMN NO.130)



(CONCRETE DESIGN FOR COLUMN NO.715)



(DEFLECTION FOR COLUMN NO.715)



(SHEAR BENDING FOR BEAM NO. 715)

B E A M N O. 79 D E S I G N R E S U L T S

M35 Fe500 (Main) Fe500 (Sec.)

LENGTH: 5000.0 mm SIZE: 300.0 mm X 550.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	1250.0 mm	2500.0 mm	3750.0 mm	5000.0 mm
TOP REINF.	2051.66 (Sq. mm)	743.39 (Sq. mm)	0.00 (Sq. mm)	768.83 (Sq. mm)	2046.09 (Sq. mm)
BOTTOM REINF.	1741.10 (Sq. mm)	794.30 (Sq. mm)	263.67 (Sq. mm)	794.44 (Sq. mm)	1403.61 (Sq. mm)

SUMMARY OF PROVIDED REINF. AREA

SECTION	0.0 mm	1250.0 mm	2500.0 mm	3750.0 mm	5000.0 mm
TOP REINF.	7-20í 2 layer(s)	3-20í 1 layer(s)	2-20í 1 layer(s)	3-20í 1 layer(s)	7-20í 2 layer(s)
BOTTOM REINF.	9-16í 2 layer(s)	4-16í 1 layer(s)	3-16í 1 layer(s)	4-16í 1 layer(s)	7-16í 2 layer(s)
SHEAR REINF.	2 legged 8í @ 180 mm c/c	2 legged 8í @ 180 mm c/c	2 legged 8í @ 180 mm c/c	2 legged 8í @ 180 mm c/c	2 legged 8í @ 180 mm c/c

(DETAILED OF TOP, BOTTOM REINFORCEMENT AND PROVIDED

REINFORCEMENT PROVIDED FORBEAM 79)

M35 Fe500 (Main) Fe500 (Sec.)

LENGTH: 5000.0 mm SIZE: 300.0 mm X 550.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	1250.0 mm	2500.0 mm	3750.0 mm	5000.0 mm
TOP REINF.	1568.32 (Sq. mm)	560.71 (Sq. mm)	0.00 (Sq. mm)	472.92 (Sq. mm)	1088.37 (Sq. mm)
BOTTOM REINF.	1051.37 (Sq. mm)	495.08 (Sq. mm)	264.69 (Sq. mm)	594.96 (Sq. mm)	941.40 (Sq. mm)

SUMMARY OF PROVIDED REINF. AREA

SECTION	0.0 mm	1250.0 mm	2500.0 mm	3750.0 mm	5000.0 mm
TOP REINF.	5-20í 1 layer(s)	3-20í 1 layer(s)	2-20í 1 layer(s)	3-20í 1 layer(s)	4-20í 1 layer(s)
BOTTOM REINF.	10-12í 2 layer(s)	5-12í 1 layer(s)	3-12í 1 layer(s)	6-12í 1 layer(s)	9-12í 2 layer(s)
SHEAR REINF.	2 legged 8í @ 180 mm c/c	2 legged 8í @ 180 mm c/c	2 legged 8í @ 180 mm c/c	2 legged 8í @ 180 mm c/c	2 legged 8í @ 180 mm c/c

(DETAILED OF TOP, BOTTOM REINFORCEMENT AND PROVIDED REINFORCEMENT PROVIDED FORBEAM 79)

```
          C O L U M N   N O.   1817  D E S I G N   R E S U L T S

       M35                   Fe500 (Main)              Fe500 (Sec.)

   LENGTH:  3500.0 mm   CROSS SECTION:  750.0 mm X  750.0 mm  COVER: 40.0 mm

   ** GUIDING LOAD CASE:    1 END JOINT:   697  SHORT COLUMN


   REQD. STEEL AREA   :      4500.00 Sq.mm.
   REQD. CONCRETE AREA:   558000.00 Sq.mm.
   MAIN REINFORCEMENT : Provide  40 - 12 dia. (0.80%,   4523.89 Sq.mm.)
                        (Equally distributed)
   TIE REINFORCEMENT  : Provide  8 mm dia. rectangular ties @ 190 mm c/c

   SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)
   ----------------------------------------------------------
   Puz :  10476.00   Muz1 :    626.14   Muy1 :    626.14

   INTERACTION RATIO: 0.04 (as per Cl. 39.6, IS456:2000)

   SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)
   ----------------------------------------------------------
   WORST LOAD CASE:    12
   END JOINT:   722 Puz :  10484.58   Muz :    840.87   Muy :    840.87   IR: 0.16
   ----------------------------------------------------------------------------



          C O L U M N   N O.   1934  D E S I G N   R E S U L T S

       M35                   Fe500 (Main)              Fe500 (Sec.)

   LENGTH:  3500.0 mm   CROSS SECTION:  800.0 mm X  800.0 mm  COVER: 40.0 mm

   ** GUIDING LOAD CASE:    2 END JOINT:   734  SHORT COLUMN

--------------------------------< PAGE 2665 Ends Here >---------------------------
    STAAD SPACE                                              -- PAGE NO. 2666


   REQD. STEEL AREA   :      5120.00 Sq.mm.
   REQD. CONCRETE AREA:   634880.00 Sq.mm.
   MAIN REINFORCEMENT : Provide  48 - 12 dia. (0.85%,   5428.67 Sq.mm.)
                        (Equally distributed)
   TIE REINFORCEMENT  : Provide  8 mm dia. rectangular ties @ 190 mm c/c

   SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)
   ----------------------------------------------------------
   Puz :  11919.36   Muz1 :    778.52   Muy1 :    778.52

   INTERACTION RATIO: 0.01 (as per Cl. 39.6, IS456:2000)

   SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)
   ----------------------------------------------------------
   WORST LOAD CASE:     6
   END JOINT:   759 Puz :  12030.25   Muz :    947.82   Muy :    947.82   IR: 0.12
```

(REQUIRED STEEL AND CONCRETE AREA, MAIN AND TIE RENFORCEMENT, SECTION CAPACITY FOR COLUMN NO. 1817 AND 1934)

Chapter-5: CONCLUSION

From the above comparison between two 30-storey building taking same beam and column size using different load combination it was clearly visible that the top beams of a building in seismic load combination required more reinforcement than the building under wind load combination (for example beam no 1952 required 7 no of 12 mmØ and 6 no of 12 mmØ bars whereas for wind load combination it required 5 nos of 12 mmØ and 4nos of 12 mmØ).but the deflection and shear bending is more in wind load combination compare to seismic. But in lower beams more reinforcement is required for wind load combination.

For column the area of steel and percentage of steel always greater required for wind load combination than the seismic load combination.

(example column no 79 A_{st} required for WL combination is 5850 mm^2 and percentage of steel is 1.04 where as for the SL combination A_{st} required is 5400 mm^2 and percentage of steel is .98) .The deflection value is more in WL combination than the SL combination.

REFERENCES

1. IS 875 (Part III for wind load design).

2. IS 456.

3. IS 1893 (for seismic analysis).

4. STAAD-Pro user guide.

5. Earthquake Resistant Design Of Structures By Pankaj Agarwal.